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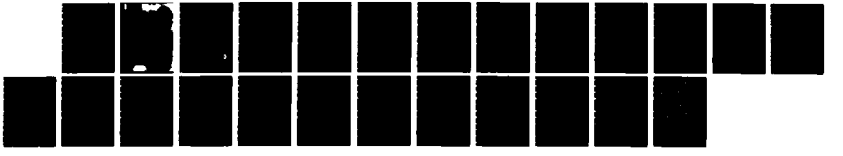

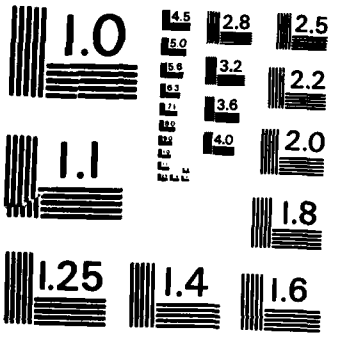

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Development of Computer-Supported Assessment and Treatment Consultation for Emotional Crises (CATCEC) for a Submarine Environment

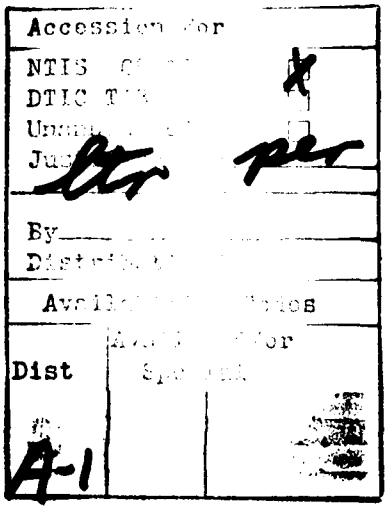
A Final Report for

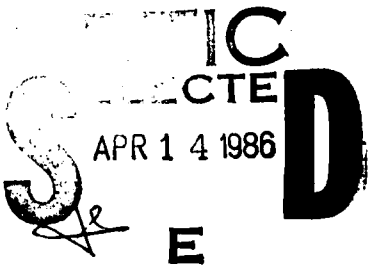
Contract N00014-83-0127 between:

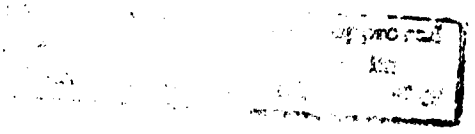
THE CURATORS OF THE UNIVERSITY OF MISSOURI

AND

THE NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND







Final Report

Title: **Development of Computer-Supported Assessment and Treatment Consultation for Emotional Crises (CATCEC) for a Submarine Environment**

Principal Investigator: James L. Hedlund, Ph.D., Professor, Department of Psychiatry, School of Medicine, University of Missouri-Columbia, and Director, Missouri Institute of Psychiatry, 5400 Arsenal Street, St. Louis, Missouri 63139

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Principal Investigator: James L. Hedlund, Ph.D., Professor, Department of Psychiatry, School of Medicine, University of Missouri-Columbia, and Director, Missouri Institute of Psychiatry, 5400 Arsenal Street, St. Louis, Missouri 63139

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Project Dates: January 1, 1983 - March 31, 1986

Abstract:

The purpose of this research was to develop a microcomputer-based expert system to assist medical corpsmen in their evaluation and treatment of emotional crises which may occur during submarine patrols. A brief structured interview, with verbatim questions to be asked was developed for use by medical corpsmen, to help collect necessary information about any emotional or behavioral crisis, and specific diagnosis and treatment suggestions were developed for each interview profile. Both of these components were systematically evaluated by mental health clinical experts, and modified as appropriate, before this consultation system was programmed for microcomputer use. The resulting expert system (CATCEC) collects, stores and summarizes individual patient information which the Corpsman collects, and makes specific diagnosis and treatment suggestions that are within the Corpsman's general trained skill levels. A CATCEC computer-aided instruction component was also developed, however, to provide the Corpsman with initial training in some general emotional emergency treatment principles. The CATCEC system was designed to be a psychiatric component of the Navy's more comprehensive computer-supported medical consultation system, MEDIC.

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Final Report:

I. **Objective:** The objective of this research was to develop a microcomputer-based expert system for nuclear submarine, onboard use that would provde assistance to medical corpsmen in the evaluation and treatment of emotional/behavioral crises which may occur during submarine patrols.

II. **Background:**

A. Medical Emergencies During Submarine Patrols.

Inasmuch as physicians have not been regularly assigned to nuclear submarines in the U.S. Navy since 1972, the medical responsibilities on board submarines have been assumed by a senior enlisted Navy Hospital Corpsman (Henderson, Moeller, Ryack, and Shumack, 1978). Although all medical corpsmen assigned to submarines have been given a six-month special course of instruction at the Naval Undersea Medical Institute, and some have additional training to function in isolated areas where no physician is immediately available, their clinical skills and abilities are nonetheless limited as compared with fully trained physicians.

Henderson, Ryack, Moeller, Post, and Robinson (1980) point out that questions of diagnosis, prognosis and treatment in this situation not only materially affect the quality of patient care, but also significantly impinge on the mission of the submarine. "This is especially true when management of the patient requires that he be evacuated to a primary care facility (MEDEVAC). Because a MEDEVAC exposes the submarine's position, its mission is for a period compromised, a condition which can detract from our country's ability to retaliate if attacked with nuclear weapons. Thus, the national defense can be affected by a MEDEVAC" (Henderson et al., p. 1).

B. Computer-based Diagnostic Information System (MEDIC).

The Naval Submarine Medical Research Laboratory at Groton, Connecticut, is attempting to alleviate some of the problems associated with submarine medical emergencies by developing and testing on-board computer-based medical support systems for the submarine corpsmen. "In its eventual form, programs will be provided in two main areas: real-time patient management, including diagnosis, prognosis, and treatment on common medical problems such as abdominal and chest pain; and computer-assisted instruction for continuing medical education while on patrol (e.g., in cardiopulmonary resuscitation) and to complement the patient management programs (e.g., simulation of patients with acute abdominal pain). The system is implemented on a computer which is already on board submarines for other applications. Programs are provided on a magnetic tape cartridge" (p.1, Henderson et al, 1980).

Inasmuch as nearly half of the submarine MEDEVACs involve patients with acute abdominal pain (Hester, 1971; Ryack, Moeller, Ross, Smack, and Arsu, 1976; Wilken, 1969), the first major effort to provide computerized medical support systems has had to do with the evaluation of abdominal pain and its management (Henderson et al, 1978, 1980). This computer system (Arthur, 1982) is a modification of one developed by deDombal (1972) at the University of Leeds. It involves entry of standardized physical examination data obtained by the medical corpsman into an on board Tektronix 4051 desk-top computer. Processing of this data for each patient yields a summary and set of diagnostic probabilities that aid in treatment decisions. Initial evaluations (Henderson, 1981; Robinson, Ryack, and Moeller, 1980; Ryack, deDombal, Moeller, and Softley, 1980; Ryack, Henderson, Moeller, Robinson, Post, and Schroeder, 1979), have yielded very favorable results and this system is currently undergoing extensive field testing. Other MEDIC modules in development include consultation programs for chest pain and orthopedic problems, and dental emergencies.

C. Emotional Crises During Long-term Submarine Patrols.

A number of reports (Ninow, 1963; Satloff, 1967; Serxner, 1968; Weybrew and Noddin, 1979; Wilken, 1969) have contributed to our knowledge of the incidence of psychiatric attrition during submerged nuclear submarine missions. As summarized by Weybrew and Noddin (1979), estimates of the gross incidence rates for emotional and behavioral problems range from 4 to 50 per 1,000 submariners.

In their study of 261 submarine crewmen who were disqualified for further submarine duty by reason of some adjustment or psychiatric problem while assigned to an operating submarine, Weybrew and Noddin (1979) found the following primary symptoms.

Symptoms	Occurrence
Anxiety	50
Interpersonal Problems	39
Depression	29
Sleep Problems	25
Performance Decrement	17
Claustrophobia	15
Suicidal Ideation	13
Non-specific, "Cannot adapt"	11
Motivational Decrement	10
Eating Problems	10
Drug/Alcohol Abuse	9
Fragile Reality Contact	9
Disciplinary Problems	8
Psychosomatic Signs	8
Gastrointestinal	6
Headaches	6
Excessive Muscle Tension	5
Impulsive Behavior	4
Confused Thought Patterns	3
Speech-related Problems	3

D. Recent Use of Structured (Standardized) Interviews for Assessment and Diagnosis of Psychiatric Problems.

In their extensive review of structured psychiatric interviews, Hedlund and Vieweg (1981) have identified and described many formal interview schedules for assessing and diagnosing psychiatric problems. Some of these interviews have been developed for use by nonphysicians and/or for use with nonpsychiatric patients, and computer programs have been written for some, such that the interview results lead to a computer diagnosis. Many studies have now indicated that the proper use of such structured interviews can significantly improve the reliability of psychiatric diagnosis, even with nonphysician interviewers.

E. ONR Contract N0014-83-0127.

A ONR contract (N00014-83-K-0127) was awarded to develop a brief structured interview for use by a medical corpsman in evaluating emotional or behavioral crises that may occur during long-term submarine patrols; and to develop a microcomputer-supported consultation system that would collect, store and process interview information so as to make specific treatment suggestions that are within the corpsman's trained skill levels and appropriate to the submarine environment. It was intended that this computer system (CATCEC) would be developed as a potential "psychiatric component" for the larger MEDIC computer-based diagnostic information system.

III. Development of the Expert System: CATCEC.

A. Development and Testing of the Structured Interview.

Existing structured psychiatric interviews and clinical rating scales were reviewed to determine their applicability for use by the corpsman in the submarine setting. None of the current interviews or scales appeared to be appropriate for direct use by submarine medical corpsmen either because they are too lengthy, too complex, required sophisticated clinical judgment, or have narrow or inappropriate clinical content. However, existing interview schedules and clinical rating scales were useful in generating a potential "item pool" for each target symptom.

Selection of interview items. The following criteria were used in selecting interview items for the Groton Interview Schedule (GIS):

1. The overall interview should be brief -- approximately thirty minutes. Although it was believed initially that this essentially ruled out a formal (DSM III) diagnostic approach, in favor of assessment procedures and treatment/management decisions that would be made on a more problem-specific basis, it became evident that medical decisions (especially treatment with psychotropic drugs) are very closely linked to diagnostic judgments. Thus, although the number of interview items had to be kept minimal, they nonetheless had to adequately address broader issues of differential diagnosis as well as specific symptoms and complaints.

2. The interviw questions had to target relatively simple, behaviorally explicit problems or symptoms for which the patient or others could provide direct information.

3. The interview questions had to be appropriate to the setting. That is, they should key on target symptoms most frequently associated with prior submarine experience, while omitting unnecessary sensitive questioning or probing. They also had to take into account unique aspects of the submarine environment (e.g., confinement, sleep deprivation, isolation, required procedural compulsitivity).

4. Interview items were selected which were specifically and/or differentially relevant to the range of treatment available. Questions had to contribute relatively directly to an understanding of severity of the problem and/or to differential treatment decisions.

5. Although emphasis was placed on collecting as objective information as possible from the patient, certin observations and judgments by the medical corpsman were believed to be critical to the assessment and treatment decisions to be made. A number of relatively open-ended interview questions were therefore included which are intended to provide a better basis for those corpsman observations and judgments.

6. Both interview items, themselves, and the interview procedures have been selected so as to have clinical credibility (i.e., have general face validity for the patient and for trained clinical experts).

Mode of interview presentation. Initially interview questions were developed as an interactive computer application. It was thought that this mode would facilitate construction and modification of the structured interview. Optimal use could be made of branching techniques to help insure that the interview would be brief, efficient and appropriate for any given patient, and still conceptually cover a wide range of emotional and behavioral problems. The goal was to include a full range of basic screening questions for all patients, and to branch to more detailed inquiry only when a screening question was answered positively or when the patient's previous pattern of responses suggested the appropriateness of more detailed or "sensitive" questioning.

Although the clinical computer literature would support a patient interactive strategy, both in terms of user acceptance and the clinical usefulness of results, other considerations resulted in a decision to modify the mode of presentation. One potential problem with the interactive computer interactive interview had to do with the location of submarines' microcomputers; it is uncertain whether a terminal will be available in a location that is suitable for patient involvement. Also, it is critical that the corpsman be in a position to make clinical observations about each patient's description of his problem, preferably as a part of the interview process. Therefore, an interpersonal mode of presentation was chosen, in which the corpsman will conduct a structured interview by following a detailed paper-and-pencil format. Although this decision has necessarily limited the use of complex branching techniques, the basic concept of screening questions and simple branching to more detailed probes whenever positive responses are given is still being used.

Corpsman clinical observation and data entry. Following a GIS structured interview with a patient, the corpsman will interactively enter information obtained on the Tektronix computer. The computer will prompt and ask him for the patient's response to each question and for his own observations and judgments about the patient. Asking for the corpsman's observations and clinical judgments at this time, interactively with the computer (rather than as a part of the on-going paper-and-pencil GIS guided interview), has a number of specific advantages: it permits the possible inclusion of a wide range of possible corpsman observations but with the flexibility and economy of asking the corpsman for only those observations which are most relevant to the patient's interview profile; and it does not interrupt the continuity of the clinical interview or require duplicative recording (once during this interview and again thereafter).

Physical examination. One special type of corpsman observation is concerned with the physical examination of the patient. Because a number of very specific physical examination findings may be critical to the assessment of emotional and behavioral emergencies, a specific section of the GIS is devoted to those important signs and symptoms. This physical

examination segment is intended to act as a guide and checklist that will be completed prior to the structured interview, itself; and the resulting data will be entered into the Tektronix computer along with other interview information and the corpsman's behavioral observations.

Current status of the GIS. Since the initial draft of the Groton Interview Schedule (GIS) was completed in March 1983, it has gone through nearly a dozen major revisions -- as the result of additional information needs associated with the development of GIS diagnosis and treatment models, as the result of direct consultation with the Behavioral Sciences Department of the Naval Submarine Medical Research Labs, and as the result of independent, formal consultation with five mental health clinical experts (four board-certified psychiatrists and one clinical psychologist) at various stages of its development.

The GIS is composed of five sections:

1. The first is a brief section to identify the Referral Source.

2. The second section is concerned with information about the Presenting Problem -- including indications of any relevant organic etiologic factors, such as alcohol or drug use, head trauma or physical illness. This section also permits the corpsman to indicate that the patient is unable to continue with the structured interview during the initial emergency contact, and to indicate why -- i.e., that the patient is too "belligerent," "violent," "psychotic," "hyperactive," "anxious," "depressed," has "attempted suicide," or is "mute."

3. The third section, the Physical Examination, contains 42 critical signs and symptoms that may be crucial to determining whether the patient's emotional crisis is organically based.

4. The Structured Interview, itself, contains 13 "key" screening questions that will be asked of all patients, another three key questions to be answered by the Corpsman concerning all patients, the detailed follow-up questions that would be asked if any key question is answered so as to indicate some type of problem (e.g., difficulty with sleep or appetite, feeling tense, anxious or depressed, difficulty with memory, being confused, having unpleasant thoughts, etc.).

5. The fifth section, Final Corpsman Interactive Ratings, which is not a part of the interview itself, contains questions to the corpsman about his behavioral observations and judgments about the patient. The Corpsman will answer these questions as he enters data following his GIS interview with the patient.

B. Development and Testing of the Diagnosis/Treatment Suggestions.

1. Diagnostic Models.

CATCEC diagnostic concepts have generally followed those of the Diagnostic and Statistical Manual of Mental Disorders, Third Edition (DSM-III), of the American Psychiatric Association (1980). Although practical considerations have dictated the selection of relatively broad diagnosis groups for this application, and the use of somewhat more lenient and "flexible" diagnostic criteria, over forty CATCEC diagnostic models (see Table 1) have been developed, using specific GIS items to satisfy DSM-III diagnostic criteria.[1]

The flow diagram of Figure 1 provides an overview of the general CATCEC diagnosis logic which leads to specific treatment suggestions.

2. Treatment Suggestions.

Treatment options that were chosen for inclusion in the CATCEC programs had to be within the general range of Medical Corpsman skills. Such treatment options include a wide range of specific medical emergency procedures, administering medication, looking after the general physical well-being and comfort of the patient, non-directive listening, taking medical histories, providing medical information to the patient, direct behavioral management (including the use of physical restraints and some simple behavior modification instructions[2]), potential environmental manipulation (such as change of duty assignments), and recommendations for medical evacuation.

Standard treatment suggestions for each psychiatric diagnosis, and for major problem areas when no likely diagnosis is available, were adduced from several well-known texts which deal with psychiatric emergencies (especially, Fauman & Fauman, 1981; Greist, Jefferson, & Spitzer, 1982; Slaby, Lieb, & Trancredi, 1981) and the general clinical psychopharmacology research literature. These standard treatment procedures, together with their explicitely associated

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[1]A Critical review of CATCEC diagnostic models with the Behavioral Sciences Department at the Naval Submarine Medical Research Laboratories resulted in the decision, for this application, to drop specific consideration of formal diagnoses having to do with alcoholism, drug addiction, and somatization disorder, and to limit the scope of personality disorder assessment. These decisions were based on the belief that those diagnoses were not principal problem areas in the submarine environment, and on the desire to eliminate the very lenghty, detailed interview sections which were necessary to establish diagnoses in those areas.

[2]Discussions and planning with the Behavioral Sciences Department at the Naval Submarine Medical Research Laboratories seemed to contra-indicate any attempt to include more formal or sophisticated behavior modification procedures which might go beyond the accepted image and/or skills of the medical Corpsman.

Table 1: Summary of CATCEC Diagnosis Models

ORGANIC MENTAL DISORDERS

DELIRIUM

- Alcohol Withdrawal Delirium
- Amphetamine or PCP Delirium

DEMENTIA

AMNESTIC SYNDROME

ORGANIC DELUSIONAL SYMDROME

- Amphetamine Delusional Disorder
- Cannabis Delusional Disorder
- Hallucinogen Delusional Disorder

ORGANIC HALLUCINOSIS

- Alcohol Hallucinosis
- Hallucinogen Hallucinosis

ORGANIC AFFECTIVE SYNDROME

- Hallucinogen Affective Disorder

ORGANIC PERSONALITY SYNDROME

INTOXICATION

- Alcohol Intoxication
- Alcohol Idiosyncratic Intoxication
- Amphetamine Intoxication
- Anticholinergic Intoxication
- Barbiturate Intoxication
- Cocaine Intoxication
- Caffeine Intoxication
- Cannabis Intoxication
- Inhalant Intoxication
- Minor Tranquilizer Intoxication
- Opioid Intoxication
- PCP Intoxication

WITHDRAWAL

- Alcohol Withdrawal
- Amphetamine Withdrawal
- Barbiturate Withdrawal
- Minor Tranquilizer Withdrawal
- Opioid Withdrawal
- Tobacco Withdrawal

FUNCTIONAL DISORDERS

SCHIZOPHRENIC DISORDER

PARANOID DISORDER

BRIEF REACTIVE PSYCHOSIS

AFFECTIVE DISORDERS

- Depressive Episode
- Manic Episode

ANXIETY DISORDERS

- Phobias
- Panic Disorder
- Obsessive-Compulsive Disorder
- Post-Traumatic Stress Disorder

PERSONALITY DISORDERS

- Antisocial Personality Disorder
- Paranoid Personality Disorder
- Passive Aggressive Personality Disorder
- Borderline Personality Disorder
- Histrionic Personality Disorder
- Narcissistic Personality Disorder
- Dependent Personality Disorder
- Schizoid Personality Disorder
- Compulsive Personality Disorder

Figure: CATCEC General Rx Models: GENERAL CONCEPTS

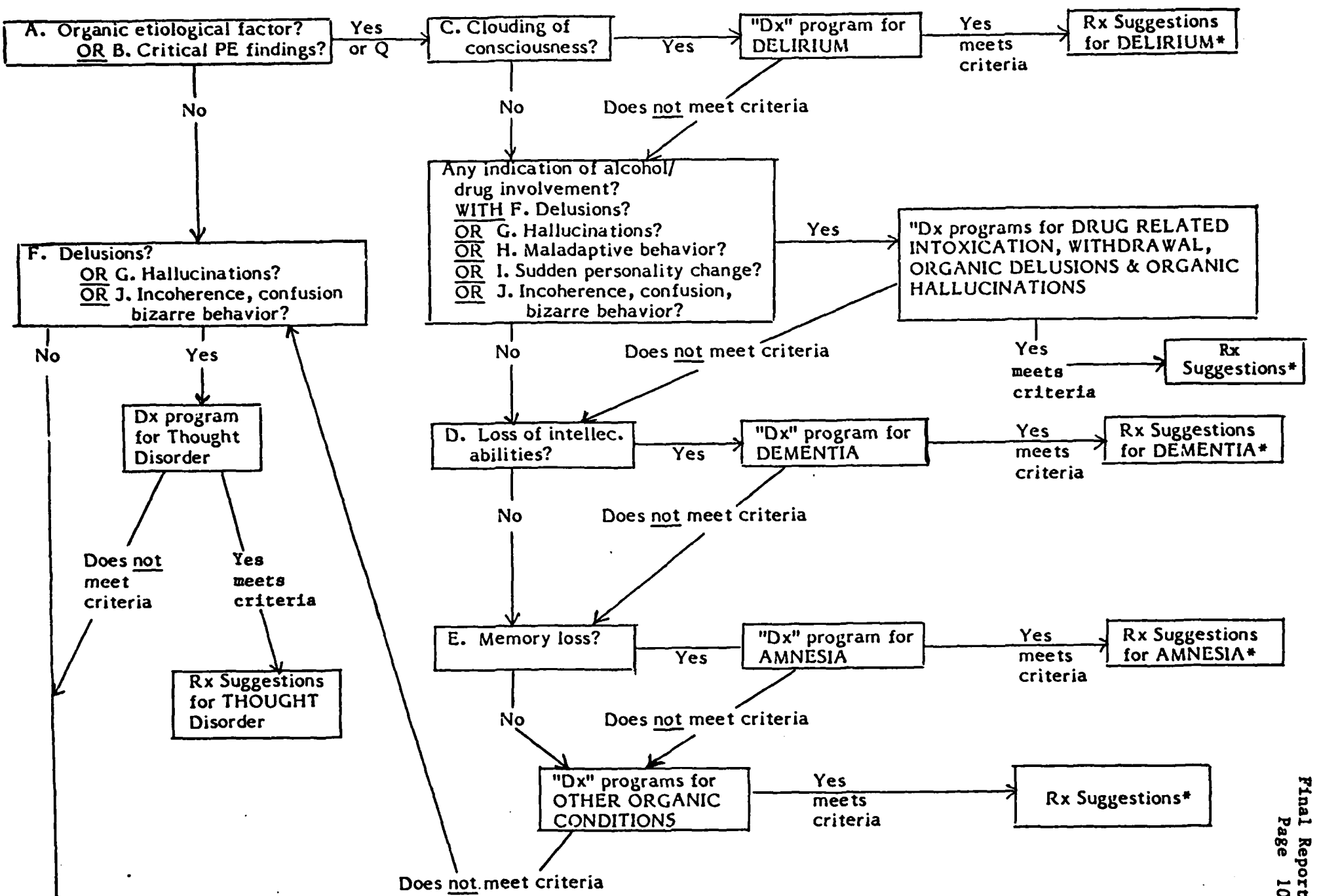
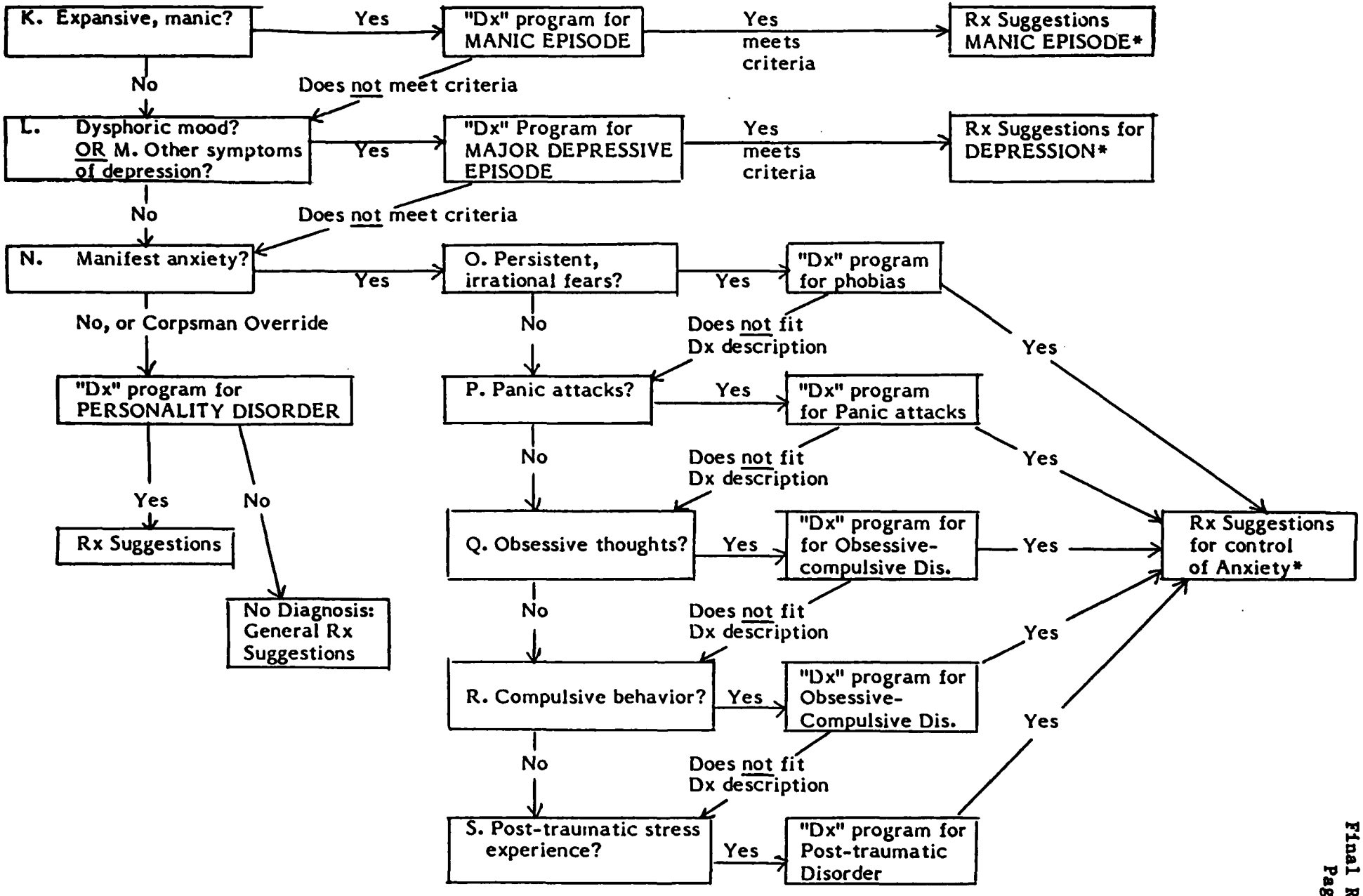


Fig 1: CATCEC General Rx Models: GENERAL CONCEPTS



*Corpsmen may also override organic factors to obtain most likely functional and personality diagnoses; and override functional diagnosis to obtain personality diagnoses.

GIS profiles, were then systematically reviewed by several experienced mental health professionals (six psychiatrists and one clinical psychologist, two of whom were experienced U.S. Navy officers). For each diagnosis or problem area, each of the clinical specialists was asked to rate whether the GIS criterion information, or profile, was adequate to make treatment decisions, and whether the suggested treatment procedures were appropriate for that type of problem. The consultants were also asked to make specific comments or suggestions about the GIS profiles and their related treatment suggestions.

Table 2 summarizes the overall agreement of all clinical experts for all CATCEC diagnosis/treatment models with respect to the adequacy of GIS information for making treatment decisions, and with respect to the appropriateness of the specific treatment suggestions for each diagnosis. As shown in Table 2, experts agreed 96% of the time that the GIS information was at least adequate for making treatment decisions in the setting involved (and agreed 65% of the time that the GIS information would be consistent with the amount of patient information available in a typical emergency setting). Experts also agreed 94% of the time that the specific CATCEC treatment suggestions were reasonable and appropriate for the submarine setting. The expert consultants, specific comments and suggestions were used to make appropriate changes in initial CATCEC treatment procedures.

Standard Psychotropic Medication. Many considerations -- limited storage space on the submarine, keeping logistical support as simple and economic as possible for world-wide submarine operations, the relative lack of specialized expertise of medical corpsmen, and the scientific/professional literature concerning psychopharmacology -- seemed to support the initial decision that the availability of a single psychotropic medication in each major problem area -- anxiety, depression and psychotic symptoms -- would probably be adequate for the infrequent emotional and behavioral problems encountered in the special setting involved. Consultation with several clinical experts, in addition to a careful literature review, resulted in the initial selection of the following "standard" psychotropic medications:

Diazepam (Valium, for acute manifest anxiety;

Alprazolam (Xanax), for agitation and anxiety with acute depressive symptoms (this was chosen in an effort to provide possible relief more quickly than would be likely with a tricyclic antidepressant);

Desipramine hydrochloride (Desipramine), as a "last resort" for acute endogenous depressive episodes;

Haloperidol (Haldol), for acute manic psychotic or violent behavior; and

Temazepan (Restoril), as a short-acting hypnotic for simple insomnia;

Table 2: Overall Expert Agreement Concerning the Adequacy of GIS Profiles and Treatment Suggestions (Across All CATCEC Diagnosis/Treatment Models)

Question/Rating	Overall % - Agreement
1. Is the criterion information provided by the Groton Interview Schedule (GIS) adequate to make a treatment or management decision concerning this problem? (circle one)	
a. Yes, the amount of patient information is fully consistent with the typical psychiatric emergency setting.	65
b. Yes, although the GIS information is somewhat more limited than would be the case in a normal psychiatric emergency practice, it is reasonable and adequate for the special setting involved.	31
c. Yes, with minor revisions (please write specific suggestions directly in margins of the protocol, and on the back side of each page, as appropriate).	4
d. No, patient information provided by the GIS is inadequate to make treatment decisions for this type of problem (*please write specific suggestions directly in the* margins of the protocol, and on the back side of each page, as appropriate).	0
2. Are the treatment or management suggestions medically appropriate for this type of problem? (circle one)	
a. Yes, the treatment suggestions are fully consistent with typical psychiatric emergency setting.	56
b. Yes, the treatment suggestions are more limited than would be the case in a typical psychiatric emergency setting, they are reasonable and appropriate for the special setting involved.	28
c. Yes, with minor revisions (please write specific suggestions directly in the margins of the protocol, and on the back side of each page, as appropriate).	14
d. No, the treatment or management suggestions for this problem are not acceptable (please write specific suggestions directly in the margins of the protocol, and on the back side of each page, as appropriate).	2

Benztropine mesylate (Cogentin), for any extrapyramidal symptoms associated with haloperidol side-effects; and

Methadone hydrochloride, naloxone, physostigmine salicilate, and phenobarbital or pentobarbital for specific drug reactions.

Suggestions from the clinical expert evaluation study indicated that this list could be simplified by eliminating alprazolam (Xanax) and temazepan (Restoril) simply by extending the use of Valium. To avoid worldwide logistical problems and much expense, three drugs already stocked and available to Medical Corpsmen were also substituted for three other, slightly preferred ones -- i.e., chlorpromazine (Thorazine, for haloperidol (Haldol), Benadryl for Cogentin, and morphine sulfate for methadone hydrochloride.

Thus, CATCEC's current list of standard psychotropic medications is:

Chlorpromazine (Thorazine)
Desipramine Hydrochloride
Diazepam (Valium)
Diphenhydramine hydrochloride (Benadryl)
Morphine sulfate
Naloxone (Narcan)
Physostigmine salicylate (Antilirium Injectable)

Haloperidol (Haldol), benztropine mesylate (Cogentin), and methadone hydrochloride are still recommended for optional use when available.

C. The Microcomputer-Supported Expert System.

Figure 2 shows the integration of information obtained from the GIS (the INPUT) with a KNOWLEDGE BASE, consisting of DSM-III diagnostic rules (in the form of explicit GIS profiles) and standard treatment principles (adduced from the clinical and research literature, and affirmed by a specific group of clinical experts), to provide diagnostic and treatment suggestions about a specific patient for the use of the Medical Corpsman (the OUTPUT).

Figure 3 provides a diagrammatic overview of the CATCEC general procedures. Because no one without prior training about emotional emergencies can be expected to deal spontaneously with such problems effectively, it is important that the Corpsman receive some initial training about how to manage emotional emergencies, generally, and some familiarization with the CATCEC system, before he encounters actual clinical problems. It is therefore expected that the Corpsman will use the CATCEC User Manual and the related CATCEC computer-assisted instruction about emotional emergency treatment principles (see Section IV below), both for initial and "refresher" training purposes (A). When a crew member is referred to the Corpsman for some type of emotional or behavioral problem (B), the Corpsman examines the crew member by administering the Groton Interview Schedule (GIS) to obtain specific information about the problem involved (C). Whatever information is obtained is entered into the computer by the Corpsman (D), and he is then

Figure 2: Computer-Supported Assessment and Treatment Consultation for Emotional Crises (CATCEC)

INPUT: Information and clinical observations obtained from the structured interview with a patient, and from collateral sources.

KNOWLEDGE BASE:

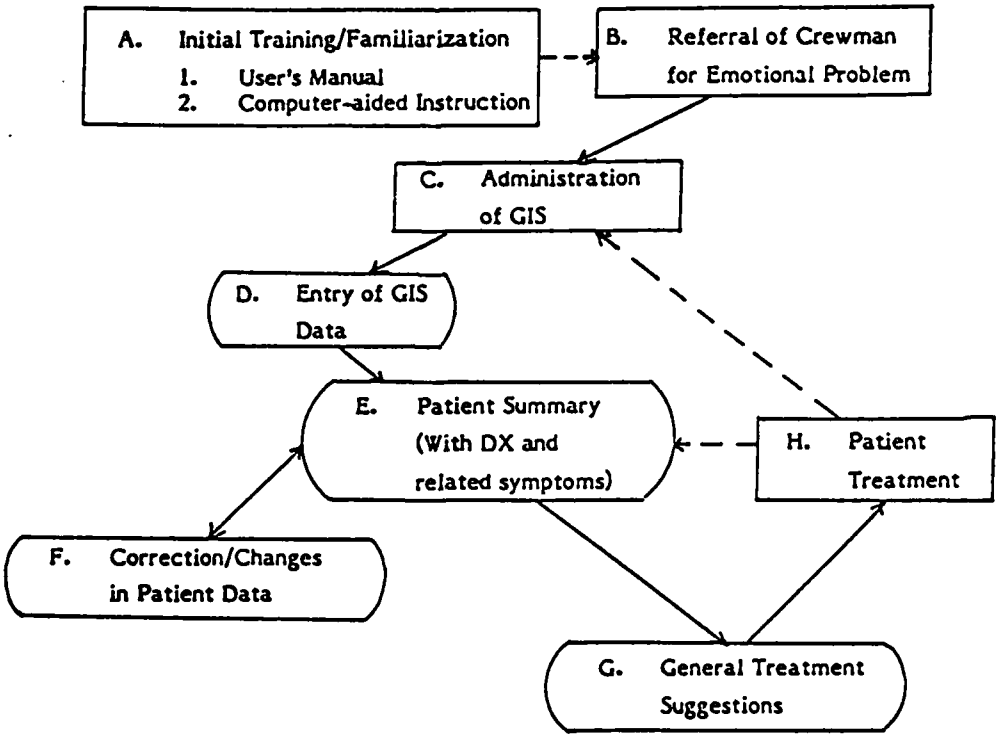
DSM-III nomenclature and diagnosis rules;

Explicitely defined sets of interview data that are used to test DSM-III inclusion and exclusion rules for each diagnosis; and

Diagnosis - and problem-related treatment principles, adduced from the scientific/professional literature for psychiatric emergencies, and corroborated by clinical experts for use in the specific remote setting involved.

OUTPUT: Discussion of probable diagnosis and specific treatment recommendations for the individual patient involved.

Figure 3: CATCEC General Procedure



able to obtain a "Patient Summary" from the computer, with a probable diagnosis and a listing of related symptoms (E). From the Patient Summary, specific changes or corrections may be made to data already entered (F) and the Corpsman may obtain treatment suggestions (G). After initial emergency treatment of the patient (H), the Corpsman may directly modify the patient's data base through the Patient Summary (E & F), complete GIS data collection that may have been impossible during the acute emergency situation, and computer process the modified patient data base for additional or more complete diagnostic and treatment suggestions (C through G, again).

Although not shown in the diagram of Figure 3 the CATCEC expert system also contains three sets of specific references in the form of glossaries (a Diagnosis and Treatment Glossary, a Medications Glossary, and a Glossary of Psychiatric Terms). These glossaries, like CATCEC's Emergency Treatment Principles, are both computerized and available as hard-copy appendices of the CATCEC User Manual. The Corpsman may refer to appropriate sections (i.e., to specific medications, diagnoses or psychiatric terminoloty), as he needs additional information. (See Section V below.)

CATCEC Computer Programs.

CATCEC, which has been implemented on the Tektronix 4052A microcomputer, is written in the Graphic System BASIC programming language. Design features are generally compatible with MEDIC's existing abdominal pain and chest pain components to facilitate the Corpsman's shifting among MEDIC's subsystems.

Although many option menus, data collection displays and the internal modular architecture are similar to other MEDIC programs, CATCEC's diagnostic and treatment decision logic is quite different. The abdominal and chest pain treatment systems are based on Bayesian statistical models, while CATCEC is rule-based. In CATCEC, a forward chaining strategy has been used, in which information collected about a patient and the diagnostic/treatment rules are applied so as to move from the observed data to the conclusions. This is in contradistinction to the backward chaining strategy often found in some expert systems written in LISP or PROLOG languages. CATCEC decision modules contain its rules and decision priorities as hard coded, program checking routines and control procedures.

Testing of Computer Programs.

The programming of CATCEC's diagnostic and treatment logic has been tested by manually entering and checking the results of over 400 GIS profiles (specific sets of GIS item responses which were manually generated so as to meet DSM-III inclusion and exclusion rules for each diagnostic or problem group, and to test every subordinate treatment rule). Programming bugs and conceptual errors were corrected as they were encountered.

IV. Development of the CATCEC Computer-Aided Instruction Component: Emergency Treatment Principles.

Although CATCEC treatment options were selected which took into account Medical Corpsman general skill levels, it must be recognized that no one could be expected to deal effectively with emotional emergencies without some specific prior training. Even having computerized or other reference material available will not permit spontaneous, uninterrupted management of such problems during the initial emergency contact -- at as very minimum, the Corpsman would have to interrupt initial information gathering to go to the available reference for help in deciding the most appropriate care for a given case.

CATCEC's computer-aided instruction (CAI) component, Emergency Treatment Principles, was developed to help meet this specific need. General treatment principles were summarized for all types of emotional emergencies, and for each of eight specific emergency prototypes: the belligerent patient, the violent patient, the psychotic or delirious patient, the hyperactive or grandiose patient, the severely anxious patient, the severely depressed patient, the suicide attempt, and the unresponsive, mute patient. The text of this material has been computerized and placed in the CATCEC User Manual as Appendix B.

The CATCEC CAI component also contains a series of programmed learning quizzes, one for each section of CATCEC's Emergency Treatment Principles, so that the Corpsman can test and reinforce his knowledge of emergency treatment principles after reading each section. The CAI quiz programs provide detailed feedback to the Corpsman about each of his responses and permit him to monitor his performance if he takes the CAI quizzes more than once.

V. CATCEC Products.

A. The following CATCEC products have been delivered to the Behavioral Sciences Department of the Naval Submarine Medical Research Laboratory at Groton, Connecticut:

1. The CATCEC User Manual, which is intended to provide orientation and training to the Medical Corpsman, both with respect to the operating procedures of the CATCEC system, itself, and with respect to the substantive procedures in emotional emergency treatment. This Manual contains five (5) appendices:

   a. A complete copy of the Groton Interview Schedule (GIS), which is used to collect patient information for input to the CATCEC expert system;

   b. Emergency Treatment Principles, which is intended to help the Corpsman learn some basic principles in the treatment of emotional emergencies before he encounters such emergencies;

   c. A Diagnosis & Treatment Glossary, which succinctly summarizes each major psychiatric diagnosis and its treatment;

d. A Medication Glossary, which provides detailed information about each of the CATCEC standard psychotropic medications, including its indications, side-effects, contraindications and complications, treatment for overdose, and specific dose procedures for various symptoms; and

e. A Glossary of Psychiatric Terms, which briefly defines many of the technical psychiatric terms used in the CATCEC programs.

2. CATCEC's General Treatment Models, which include the explicit GIS criterion sets for each diagnosis or problem area, and the explicit rules and text for all treatment suggestions.

3. Detailed documentation for CATCEC's Computer-Aided Instruction module on Emergency Treatment Principles.

4. Complete sets of CATCEC's Tektronix computer cassettes, containing all of the application programs.

5. Detailed computer program listings and technical documentation for all of CATCEC's subsystems.

B. Professional/Scientific publications:

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